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## (54) Method for manufacturing an elastic mould.

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## Descripti n

The present invention relates to a method of manufacturing elastic moulds for the production of castings for e.g ice, ice cream, chocolate, jelly, cube sugar, fish paste, soap and concrete.

Conventionally, jelly and chocolate have been produced by casting them in a large mould and cutting the cake thus formed into a prescribed size. Alternatively, an array of moulds has been used to obtain the required number of products in one lot.

However, such conventional moulds as have been used in casting confectionary materials are all metal moulds, especially split moulds. These split moulds tend to leave the joint of the mould on the surface of the product thus formed, resulting in poor appearance and lower product value. Furthermore, shape design has been restricted because certain subtle shapes including inverse-tapered shapes are hard to obtain. In addition, the use of the split mould makes it difficult to withdraw the product from the mould and is often found to be very costly.

Thus, according to this invention, an elastic mould is produced. Conventional methods for the manufacture of the elastic moulds such as rubber-made moulds comprise dipping only a pattern which itself is mounted on a plate. The elastic mould thus manufactured does not have a fixing sheet which is necessary for holding the elastic mould to a moulding machine.

US-A-2278764 discloses a method of manufacturing moulds in which the mould former is dipped vertically into an elastic mould solution but it does not disclose a method of manufacturing moulds attached to a fixed sheet. Neither does the document address the problem of producing inverse - tapered rigid articles.

Thus, the present invention seeks to provide a novel and industrially feasible method of manufacturing elastic moulds which is characterized in that the fixing sheet is produced as an integral part together with the elastic mould to replace the need for a conventional metal mould.

Accordingly, the present invention provides a method of manufacturing an elastic mould comprising at least one molding surface, each molding surface being continuous except for an open edge and defining an inverse-tapered shape, and a fixing sheet which is integrally mounted at said open edge of each molding surface which method comprises dipping a pattern unit comprising at least one inverse-tapered shape mounted on a plate into an elastic body-producing solution to form a gel-like elastic film thereon, the pattern unit being dipped at right angles to a surface of the elastic body-producing solution, withdrawing the film-coated pattern unit from the solution, drying and vulcanizing the film, and peeling the vulcanised elastic film off the pattern unit to obtain a mould having a uniform thickness and a fixing member as an integral part thereof.

The elastic mould is used as follows. A pouring step in which material is poured into an elastic mould is followed by a hardening step in which the poured material is hardened, and a withdrawal step in which the hardened object is withdrawn from the inside of the elastic mould.

In the pouring step, fixing of the elastic mould is necessary during pouring of the material. Further, the elastic body must be fixed during the hardening step.

In one example of the withdrawal step, the mould is loosened by pulling the fixing member (sheet), and then the object thus hardened is pushed from the opposite side of the fixing member attached to the mould. Hence, the fixing member also functions as a pulling member.

Alternatively, the hardened product can be removed by applying a vacuum. In that event, the fixing member supports a vacuum chamber which is tightly connected with the mould.

The object is then withdrawn by applying a vacuum. Hence, in this case the fixing member also functions as a supporting member.

An elastic mould prepared according to the present invention which comprises a pattern unit and a fixing sheet (member) which is integrally mounted at open edge of the pattern can be easily used.

In a particular embodiment of the invention a natural rubber latex solution is used as the elastic body-producing solution.

The pattern unit to be dipped in the solution may be manufactured by mounting a model pattern of predetermined shape on a plate.

Secondly, the pattern unit is dipped into a natural rubber latex solution at right angles to the surface of the solution. The latex should contain elastic rubber compositions to provide elongation for the rubber-made mould. Solidification in th mould occurs eith r by cooling or heating and the compositions of the abov rubber-made mould should vary accordingly. Oil-resistant rubber latex must be selected for an oily material such as chocolate.

The pattern unit is usually dipped in the natural rubber latex solution until the thickness of the rubber composition adhered is from 0.8 to 1.0 mm. It should be noted that the rubber compositions adh re to the

plate as well as the model pattern, both of which have been dipped into the latex solution.

Afterwards, after the object thus formed is dried in a drier at 60 - 80 °C for approximately 60 to 90 minut s, it is vulcanized. The product mould is then taken out from the pattern. It should also be noted that the mould is mounted on th surface of the rubber plate. Therefore, the flat plate thus formed functions as a fixing sheet for the product mould.

Any material can be used as the elastic body-producing solution which have a suitable flexibility (elongation). If the mould product is a foodstuff the material must be safe. Natural rubber is preferably used but other examples of suitable materials are silicone rubber, rubber or butadiene rubber.

The drawings show a preferred embodiment of this invention. Fig. 1 is a block diagram of an use of an elastic mould according to the present invention. Figs. 2 and 3 illustrate the front and side views of the pattern unit to be dipped. Figs. 4 to 9 show the manufacturing steps of the present invention. Fig. 4 is a partial, sectional view showing the pattern unit dipped into a coagulating solution. Fig. 5 is a partial, sectional view showing the pattern unit taken out from the coagulating solution. Fig. 6 is a partial, sectional view showing the pattern unit dipped into a rubber latex solution. Fig. 7 is a partial, sectional view showing the pattern unit which has been taken out from the rubber latex solution. Fig. 8 is a partial, sectional view showing a rubber film which has been detached from the pattern unit. Fig. 9 depicts the front and side views of the final rubber-made mould product.

Examples of the present invention will be described with reference to the drawings.

An elastic mould manufactured according to the process of the present invention is used for obtaining a moulding product. First, raw materials are poured into the inside of the elastic mould and allowed to solidify. Secondly, the materials thus formed are taken out as the product.

The raw materials include refrigeration-solidifying materials such as ice, and heat-solidifying materials such as fish paste. There are also some types of fat-containing materials as exemplified by chocolate. Several uses of the elastic mould prepared by this invention will be presented in the following examples.

Example 1

Example 1 relates to a method for the manufacture of rubber-made moulds for refrigeration-solidifying materials such as ice.

Figs. 2 and 3 are the front and side views of the pattern unit to be dipped (A) wherein two patterns (2) extend from both surfaces (1a) of the plate (1). The plate (1) in the pattern unit (A) is likely to be subjected to heat-treatment and should be made of heat-resistant synthetic resin such as polypropylene (PP) and ABS resin, and heat-resistant synthetic rubber such as neoprene and butadiene acrylonitrile rubber (NBR). The pattern unit (2) can be made of appropriate materials including glass, porcelain, heat-resistant synthetic resins such as polypropylene (PP) and acrylonitrile-butadiene-styrene (ABS) resin, and corrosion-resistant metals.

The pattern unit (2) comprising at least one inverse-tapered shape can be shaped as required for the product to be formed in the rubber-made mould Fancy patterns such as figures of small animals, for example, can be used as a mould for producing ice cream and chocolate.

The spacing of the pattern (2) on the plate (1) should be determined so that the width of the fixing sheet (3) is sufficient to secure the mould unit to the moulding machine.

Although details of the drawing are not shown, the joint between the pattern (2) and the plate (1) should be a rounded corner. This helps to make the thickness of rubber film uniform, and also makes it more difficult to crack the rubber surface when the vulcanized rubber film is peeled off from the pattern unit (A). An arc-like plate is more effective for these purposes than a flat plate.

The production of rubber-made moulds according to the present invention will be described in the order of production sequence. First, the forementioned pattern unit (A) is washed to remove any dirt and then dried at about 60 to 80 °C for 10 to 20 min. Secondly, the pattern unit (A) is pretreated to facilitate rubber adhesion by means of ion effects. A coagulation liquor containing 40 parts by weight of calcium nitrate, 0.5 parts by weight of glycerine, and 59.5 parts by weight of methanol is used, into which the pattern unit (A) is dipped. Reference should be made to Fig. 4.

In order to avoid entrapping air-bubbles and to provide uniformity of film thickness, it is preferable that the pattern unit (A) is dipped at a right angle to the surface of the liquor. Then, the pattern is pulled out from the coagulation liquor (a) and dried at about 70 to 80 °C for about 10 min. to evaporat the methanol. A film of calcium nitrate (m) is thus formed around the surface (1a) of the pattern unit (A).

Reference should be made to Fig. 5.

The thickness of the calcium nitrate film (m) is generally determined by the rate of pulling out. A pulling-out rate of 100 mm/min was employed in this example.

Since pretreatment is intended to provide a uniform film thickness as well as to avoid entrapping air-bubbles , this step may be omitted when a certain degree of non-uniformity of the rubber film (c) can be tolerated. A pretreatment by means of a heat-sensitive method can also be applied, in which a pattern unit (A) is preheated at about 60 • C.

Then, the pattern unit (A) pretreated in this way was wholly dipped into the rubber latex solution (b) at right angles to the surface of the solution and remained in the solution for about 10 to 15 minutes as shown in Fig.6. The surface of the pattern unit (A) was wholly covered with a rubber film (c) having a thickness of 0.8 to 1.0 mm as shown in Fig. 7.

The rubber latex (b) had the following solid contents based on the weight of each component.

| | |
|---|---|
| 60% natural rubber latex | 100.0 |
| Non-ionic stabilizer (KAOH CORPORATION: EMALGEN 810) | 0.1 |
| Potassium hydroxide | 0.3 |
| Sulfur | 1.0 |
| Zinc oxide | 0.6 |
| Mercaptobenzothiazole zincate | 0.7 |
| Diethyldithiocarbamic acid zincate | 0.2 |

The rubber film (c) was developed not only on the pattern member (2) but also on the whole surface (1a) of the plate (1), and the latter part served as the fixing sheet (3). Then, the pattern unit (A) on which the rubber film (c) had been developed was dried and vulcanized at 80 to 90 • C for about 60 to 90 minutes. Afterwards, the rubber film was peeled off from the pattern unit (A). (Fig. 8)

Then, the rubber film (c) which had been peeled off from the pattern unit (A) was immersed in a circulating water stream maintained at 60 to 65 • C for a period of approximately five hours to remove calcium nitrate and aqueous non-rubber components excluding natural rubber latex. The rubber film thus obtained was allowed to stand in a dehumidifier at 70 to 80 • C for about 15 hours to produce a rubber-made mould.

The rubber-made mould was composed of a bag-like section corresponding to the pattern member (2) and a fixing sheet (3) connecting to the open end of the pattern member (2). Therefore, a rubber-made mould applicable for a particular use can be obtained by cutting the fixing sheet (3) so as to leave the required width of the plate.

Properties of the rubber-made mould thus produced are given as follows:

| Low-temperature tensile test | | |
|---|---|---|
| | Ambient | Low temp. |
| Tensile strength (Kgf/cm$^2$) | 361 | 529 |
| Elongation (%) | 900 | 790 |
| 500% tensile stress | 36 | 88 |
| Permanent elongation (%) | 3 | - |
| * Test method<br>JIS K 6301 (Physical test method for vulcanized rubber)<br>Test temperature: -25±1 • C<br>Low temp. time: 60 minutes | | |

| Low-temperature repeated elongation test | |
|---|---|
| Elongation cycle | State |
| 3000<br>5000<br>10000 | normal<br>normal<br>tore-off |
| * Test method<br>de Mattia flexing tester<br>Test temperature: -25 °C<br>Elongation cycle: 300 cycles/min<br>Standard distance: 20 mm | |

Example 2

Example 2 relates to a method for the manufacture of rubber-made moulds for heat-solidifying materials such as fish paste.

Except for the formulation of the rubber latex solution (b), Example 2 is carried out in a way similar to Example 1. Therefore only the formulation of the latex solution (b) and the characteristics of the product or the rubber-made mould need be described.

The rubber latex (b) had the following solid contents based on the weight of each component.

| | |
|---|---|
| 60% natural rubber latex | 100.0 |
| Non-ionic surfactant (KAOH CORPORATION: EMALGEN 911) | 0.2 |
| Potassium hydroxide | 0.5 |
| Zinc oxide | 3.0 |
| Promoter, tetramethylthiuram disulfide (TT) (KAWAGUCHI KAGAKU CO.: ACCEL TMT) | 3.0 |
| Promoter, zinc ethylphenyl dithiocarbamate(PX) (KAWAGUCHI KAGAKU CO.: ACCEL PX) | 1.0 |
| Thiourea | 1.0 |
| Anti-aging agent (Phenolic) | 2.0 |

The rubber-made mould manufactured using the above rubber latex solution (b) had the following characteristics.

| Physical properties | |
|---|---|
| 300% modulus (Kgf/cm$^2$) | 13.0 |
| Tensile strength (Kgf/cm$^2$) | 321.0 |
| Elongation (%) | 900.0 |

<u>Heat-resistance test</u>

300% modulus (Retention)

| | |
|---|---|
| 100°C x 24 H | 101.5 % |
| 100°C x 48 H | 107.5 % |
| 100°C x 96 H | 103.0 % |
| 100°C x 168 H | 100.0 % |

Tensile strength (Retention)

| | |
|---|---|
| 100°C x 24 H | 95.8 % |
| 100°C x 48 H | 92.2 % |
| 100°C x 96 H | 88.8 % |
| 100°C x 168 H | 78.2 % |

Elongation (Retention)

| | |
|---|---|
| 100°C x 24 H | 98.5 % |
| 100°C x 48 H | 97.5 % |
| 100°C x 96 H | 97.8 % |
| 100°C x 168 H | 95.3 % |

Example 3

Example 3 relates to a method for the construction of rubber-made moulds for casting fat-containing materials such as chocolate.

Except for the formulation of the rubber latex solution (b), Example 3 is carried out in a similar way to Example 1. Therefore, only the formulation of the latex solution (b) and the characteristics of the product rubber-made mould will be described.

The rubber latex solution (b) had the following solid contents based on the weight of each component.

| | |
|---|---|
| Carboxylated NBR latex | 100.0 |
| Non-ionic surfactant | 0.5 |
| Potassium hydroxide | 0.75 |
| Accelerator, zinc dibutyl dithiocarbamate (BZ) (KAWAGUCHI KAGAKU CO.: ACCEL BZ) | 0.25 |
| Zinc oxide | 5.0 |
| Sulfur | 0.5 |

The rubber-made mould constructed using the above rubber-made solution (b) had the following characteristics.

| Physical properties | |
|---|---|
| 300% modulus (Kgf/cm²) | 60.0 |
| 500% modulus (Kgf/cm²) | 175.0 |
| Tensile strength (Kgf/cm²) | 316.0 |
| Elongation (%) | 580.0 |

| Oil/solv nt resistance of vulcanized rubber film | | |
|---|---|---|
| | A | B |
| Carboxylated NBR latex | 1.0 | 0.8 |
| Natural rubber | 164 | 112 |
| Chloroprene | 20 | 4 |
| * The above numerals indicate the degree of area expansion (%).<br>A: 25 °C Hexane<br>B: 25 °C ASTM #2 Oil<br>Immersion time: 24 hours | | |

The method of casting using the rubber-made mould thus constructed will be briefly described based on Fig. 1. The method comprises a pouring step X in which material is poured into a rubber-made mould, a hardening step Y in which the poured material is hardened, and a withdrawal step Z in which the hardened object is withdrawn from the inside of the rubber-made mould.

In the pouring step X, low-viscosity material can be easily poured from the top of the mould (2) while high-viscosity material can be injected through a pouring nozzle which is inserted in the mould (2). To avoid entrapping air bubbles, the nozzle is gradually lifted as the level of the material being poured rises.

In the hardening step Y, treatments such as cooling, heating, and humidification are carried out, depending upon the nature of the material.

In the withdrawal step Z, the mould (2) is first loosened by pulling the flexible fixing member (3) of the rubber-made mould, and then the object thus hardened is pushed from the opposite side of the fixing member (3) attached to the mould (2). Hence, the fixing member also functions as a pulling member.

Alternatively, the hardened product can be removed by applying a vacuum. The fixing member (3) supports a vacuum chamber which is connected tightly to the mould (2). The object is then withdrawn by applying a vacuum. Hence, in this case the fixing member also functions as a supporting member.

According to the present invention as described above, a whole of the pattern unit (A) is dipped into an elastic body-producing solution at right angles to the surface of the solution, for example, a rubber latex solution, to form a fixing member (3) as an integral part of the mould (2). The mould provides patterns for casting materials such as jelly and chocolate while the fixing member assists in the withdrawal step.

**Claims**

1. A method of manufacturing an elastic mould (M) comprising at least one molding surface, each molding surface being continuous except for an open edge and defining an inverse-tapered shape, and a fixing sheet (3) which is integrally mounted at said open edge of each molding surface which method comprises dipping a pattern unit (A) comprising at least one inverse-tapered shape (2) mounted on a plate (1) into an elastic body-producing solution (b) to form a gel-like elastic film (c) thereon, the pattern unit(A) being dipped at right angles to the surface of the elastic body-producing solution, withdrawing the film-coated pattern unit (A) from the solution (b), drying and vulcanizing the film (c), and peeling the vulcanized elastic film off the pattern unit (A) to obtain a mould (M) having a uniform thickness and a fixing member (3) as an integral part thereof.

2. A method according to claim 1, wherein the elastic body-producing solution (b) is a natural rubber latex.

3. A method according to claim 1 or 2, wherein the pattern unit (A), before it is dipped into the elastic body-producing solution (b), is pretreated with a coagulating liquor (a) containing 40 parts by weight of calcium nitrate, 0.5 parts by weight of glycerine and 59.5 parts by weight of methanol.

4. A method according to claim 1 or 2, wherein the pattern unit (A) is preheated before it is dipped into the elastic body-producing solution (b).

5. A method according to claim 1, wherein the elastic body-producing solution (b) is a solution of one of a silicone rubber, an urethane rubber and a butadien rubber.

**Patentansprüch**

1. Verfahren zur Herstellung einer elastischen Form (M), mit zumindest einer Formoberfläche, wobei jede Formoberfläche mit Ausnahme einer offenen Kante durchgehend ist und eine sich umgekehrt verjüngende Form bildet, und mit einer Halterungsplatte (3), die einstückig an der offenen Kante jeder Formoberfläche angebracht ist, wobei das Verfahren das Eintauchen einer Mustereinheit (A), die zumindest eine sich umgekehrt verjüngende Form (2) umfaßt, die auf einer Platte (1) angeordnet ist, in eine einen elastischen Körper herstellende Lösung (b) zur Bildung eines gelartigen elastischen Films (c) darauf, wobei die Mustereinheit (A) rechtwinklig zu der Oberfläche der einen elastischen Körper herstellenden Lösung eingetaucht wird, das Herausziehen der mit einem Film überzogenen Mustereinheit (A) aus der Lösung (b), das Trocknen und das Vulkanisieren des Films (c), und das Abschälen des vulkanisierten elastischen Films von der Mustereinheit (A) umfaßt, um eine Form (M) zu erhalten, die eine einheitliche Dicke und ein Halterungselement (3) als einen integralen Teil davon aufweist.

2. Verfahren nach Anspruch 1, bei dem die einen elastischen Körper herstellende Lösung (b) ein Naturkautschuk-Latex ist.

3. Verfahren nach Anspruch 1 oder 2, bei dem die Mustereinheit (A) mit einer Koagulierungsflüssigkeit (a) mit 40 Gewichtsteilen Kalziumnitrat, 0,5 Gewichtsteilen Glyzerin und 59,5 Gewichtsteilen Methanol vorbehandelt wird, bevor sie in die einen elastischen Körper herstellende Lösung (b) eingetaucht wird.

4. Verfahren nach Anspruch 1 oder 2, bei dem die Mustereinheit (A) vorgewärmt wird, bevor sie in die einen elastischen Körper herstellende Lösung (b) eingetaucht wird.

5. Verfahren nach Anspruch 1, bei dem die einen elastischen Körper herstellende Lösung (b) eine Lösung aus einem Silikonkautschuk, einem Urethankautschuk oder einem Butadienkautschuk ist.

**Revendications**

1. Procédé de fabrication d'un moule élastique (M) comprenant au moins une surface de moulage, chaque surface de moulage étant continue à l'exception d'un bord ouvert et délimitant une forme en contre-dépouille,et une feuille de fixation (3) faisant corps avec ledit bord ouvert de chaque surface de moulage, procédé comportant l'immersion d'un modèle (A),comprenant une forme en contre-dépouille (2) montée sur une plaque (1),dans une solution de production d'un corps élastique (b) pour former une pellicule élastique analogue à un gel (c) sur celui-ci, le modèle (A) étant plongé orthogonalement à la surface de la solution de production du corps élastique, le retrait du modèle (A) revêtu de la pellicule de la solution (b), le séchage et la vulcanisation de la pellicule (c), et l'arrachement de la pellicule élastique vulcanisée du modèle (A) pour obtenir un moule (M) présentant une épaisseur uniforme et un élément de fixation (3) en tant que partie faisant corps avec celui-ci.

2. Procédé selon la revendication 1, dans lequel la solution de production du corps élastique (b) est un latex de caoutchouc naturel.

3. Procédé selon la revendication 1 ou 2, dans lequel le modèle (A), avant d'être plongé dans la solution de production du corps élastique (b), est prétraité avec une liqueur de coagulation (a) contenant 40 parties en poids de nitrate de calcium, 0,5 partie en poids de glycérine et 59,5 parties en poids de méthanol.

4. Procédé selon la revendication 1 ou 2, dans lequel le modèle (A) est préchauffé avant d'être plongé dans la solution de production du corps élastique (b).

5. Procédé selon la revendication 1, dans lequel la solution de production du corps élastique (b) est une solution d'un caoutchouc aux silicones, d'un caoutchouc uréthane et d'un caoutchouc butadiène.

FIG. 1


FIG. 2

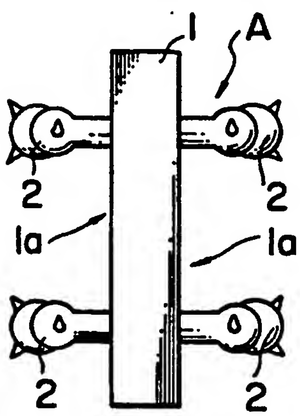


FIG. 3

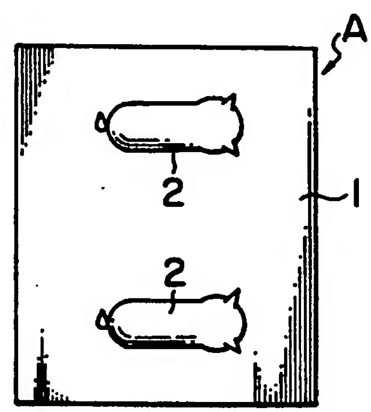


FIG. 4

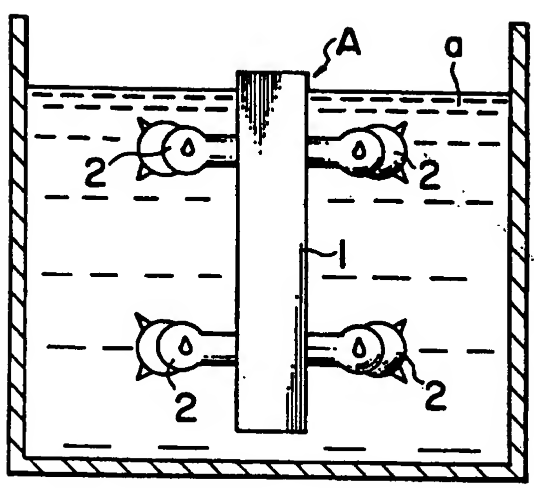


FIG. 5

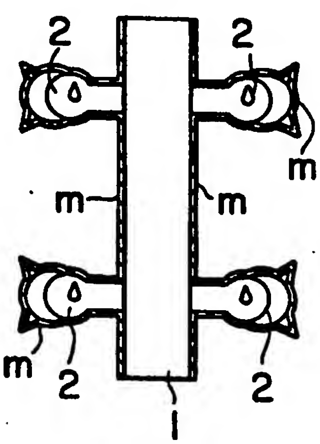

FIG. 6

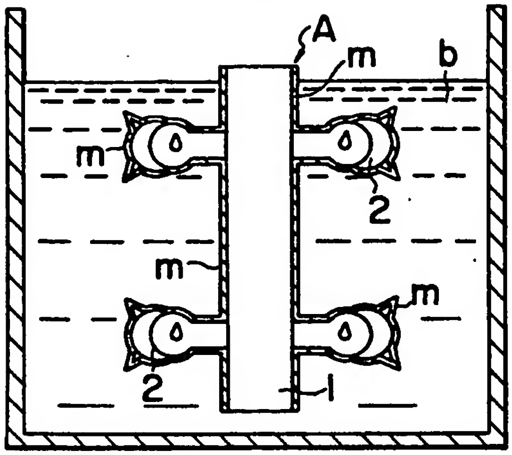


FIG. 7

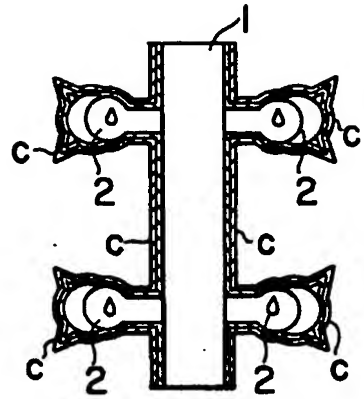


FIG. 8

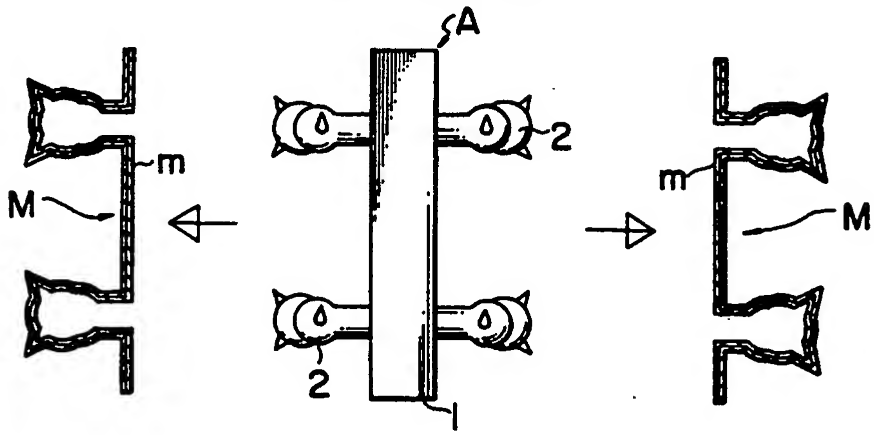


FIG. 9